REMARKS

Figure 1 of the drawings is amended, per the attached Submission, to overcome a few noted informalities contained therein. New formal drawings, incorporating the requested amendments, will follow once the requested drawing amendments are approved by the Examiner. If any further amendment to the drawings of this application is believed necessary, the Examiner is invited to contact the undersigned representative of the Applicant to discuss the same.

The Applicant thanks the Examiner for indicating that claims 20 and 32 are objected to as being dependent upon a rejected base claim but would be allowable if rewritten in independent form to include all of the limitations of the base claim and any intervening claim(s). In accordance with this indication, the subject matter of claims 20 and 32 is rewritten as new independent claims 34 and 35, respectively. New claim 34 includes the allowable subject matter of claims 17, 19 and 20 while new claim 35 includes the allowable subject matter of claims 29, 31 and 32, and both of those new independent claims 34 and 35 are now believed to be allowable. As new claim 40 depends from new independent claim 34, this dependent claim is also believed to be allowable as well.

Claims 17-31 are rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for the reasons noted in the official action. The rejected claims are 17-20, 22 and 29-31 are canceled, without prejudice, from this application while remaining rejected claims 21 and 23-28 are accordingly amended, by the above claim amendments, and the presently pending claims are now believed to particularly point out and distinctly claim the subject matter regarded as the invention, thereby overcoming all of the raised § 112, second paragraph, rejections. The entered claim amendments are directed solely at overcoming the raised indefiniteness rejection(s) and are not directed at distinguishing the present invention from the art of record in this case.

The amendments to claims 21 and 23-28 are believed to traverse the Examiner's objections under 35 U.S.C. § 112 that the claims are "incomplete in omitting essential structural

cooperative relationship of elements". However, the specific "structural cooperative relationships" which the Examiner refers to as "omitted", are not featured in the method and system of the present invention. This can be seen in the presently pending claims as well as the application (see in particular from page 5, line 15 to page 8, line 2 of the original text) and illustrated with reference to Figure 2.

In the described method and system:

(a) de-convolution (represented by arrow 29 in Figure 2) of the image edge-response function (25 - the image of the object-discontinuity 23) is carried out with sub-pixel sampling of that function, producing the line-spread profile (22');

(b) this line-spread profile (22') and the profile (25') of the image edge-response function (25) are correlated with one another;

(c) the mid-point (30) of the full-width half maximum (FWHM) of the line-spread function (22') is utilised to establish the appropriate location in the image domain for the image-representation (33) of the object-discontinuity; and

(d) sub-pixels (32) within the image-domain profile (25') of the edge-response function are transferred (31) from one side to the other of this location (30) to re-construct (represented by arrow 34) this profile (25') into a profile (33) of enhanced spatial resolution more-accurately representative in the image domain of the object-discontinuity (23).

It is to be noted that contrary to what is suggested in the Examiner's remarks, the de-convolution process is of the edge-response function (23) as it is manifest in the image domain, that is to say, of the image edge-response profile (25), and that this does not directly involve the point- or line-spread function (22) of the imaging system. In the context of Figure 2, the result of this de-convolution is the point- or line-spread function 22'. The arrows 27 and 28 in Figure 2 indicate how convolution of the point- or line-spread function 22 with the object-discontinuity 23 results in the image-profile 25, and the arrow 29 how the point- or line-spread function 22' results from de-convolution of that image-profile 25 (see in this connection also,

Figure 7). There is no requirement to derive the line-spread function 22 of the imaging system "prior to the actual object scans of interest"; indeed it is not used directly (that is to say independently of its inherent involvement in the object-scan as a characteristic of the imaging system) and does not need to be determined at all.

The term "sub-pixel sampling" is a reference to sampling at a spatial rate or frequency higher than the spatial frequency of the pixels. That is to say, the sampling will be of a spatial frequency to ensure that samples are taken at spatial intervals less than pixel size (so that the samples are "sub" pixel); according to the Nyquist sampling criteria, the sampling will normally be 3 times the pixel spatial frequency. In view of the above explanation and the entered claim amendments, it is respectfully submitted that all of the raised 35 U.S.C. § 112, second paragraph, rejections are traversed.

Next, claims 17-19, 20-31 are rejected, under 35 U.S.C. § 103(a), as being unpatentable over Hoffman et al. `292 in view of Alperin, K. R. Hoffman (XP 000147033) ("Alperin et al."). The Applicant acknowledges and respectfully traverses the raised obviousness rejection in view of the following remarks.

The disclosure of Hoffman et al. `292 relates to a method in which an iterative de-convolution process is used for determining blood-vessel size by comparison, not from enhancement of spatial resolution. In this process, the image profile of the vessel is compared with theoretical profiles that are generated by convolving the line-spread function (LSF) of the imaging system with cylinders of varying size, until the best fit with the image of the blood-vessel is found. The limitations of newly entered claims 36 and 41 include *inter alia* that the de-convolution process be carried out on the image of the object-discontinuity (the "image edge-response function") to derive from it a point- or line-spread profile, and that the appropriate location of the object-discontinuity within the image domain is identified from the mid-point of the full-width half-maximum of that point- or line-spread profile. No such limitation concerning the location of object-discontinuity in the image domain takes place or is disclosed, taught or suggested by Hoffman et al. `292 or in the paper of Alperin et al.

Moreover, neither Hoffman et al. `292 nor Alperin et al. discloses, teaches nor suggests the redistribution of sub-pixels of the image edge-response function to enhance the spatial resolution as required by the limitations of new independent claims 36 and 41. The reference in the Alperin et al. paper to achieving accuracy to one-third pixel size is a matter of sub-pixel accuracy, it does not imply the use of sub-pixel sampling. The Alperin et al. paper, like the disclosure of Hoffman et al. `292, is concerned with comparing the imaging of a blood vessel with the imaging achieved (theoretically) with cylinders having a range of different diameters, and seeking to determine the diameter of cylinder whose (theoretical) image that gives the 'best fit' with the image of the blood vessel. If the set up is such that when making the comparison with the image of the blood vessel, it is possible to discriminate for the purposes of achieving a 'best fit' between cylinders that differ in diameter by 0.1 millimeters, then an accuracy of 0.1 millimeters can be claimed. This owes nothing to pixels or sub-pixels, but is a reflection of the operational efficiency of the imaging system and orientation of the blood vessel. The fact that the claimed accuracy is related to pixel size, cannot be taken as implying sub-pixel sampling. There is nothing disclosed in either citation to suggest the use of sub-pixel sampling as presently recited.

With the method and the system of the present invention, as currently claimed, there is the advantage that the location of the discontinuity in the image domain is determined directly from the image-domain profile of the respective point- or line-spread function. This has accuracy that takes into account not only the point- or line-spread function of the imaging system itself, but also the contrast-level and partial-volume effects, and random noise as well as overshoots (for example due to filtering) that occur in the image edge-response function. These latter effects affect significantly the point- or line-spread function that results from different object-discontinuities. The fact that de-convolution is carried out with sub-pixel sampling provides for a better-defined and smoother profile of the point- or line-spread function so that the full-width half maximum (FWHM) of the point- or line-spread function can be more

accurately determined. This, in turn, leads to greater accuracy in pin-pointing the location of the object-discontinuity in the image domain.

The transfer of sub-pixels from one side to the other of the derived location of the respective discontinuity provides an empirical method of accurately enhancing the spatial resolution of the image-edge at the discontinuity. In this way, the method and the system of the invention enable loss of spatial resolution in the imaging to be recovered without the trade-off loss of other properties and, in particular, achieves this without an increase in noise in the resultant image. The original high-resolution 'step-function' feature at the discontinuity is in effect restored without an increase in noise, and the absence of increased noise is of critical importance to the provision of accurate image-definition free of any substantial smearing.

In the light of the above distinctions, it is submitted that the method and the system of new independent claims 36 and 41, and of each of their respective dependent claims, are patentable over the cited art.

The Applicant acknowledges that the additional references of may arguable related to the feature(s) indicated by the Examiner in the official action. Nevertheless, the Applicant respectfully submits that the combination of the base reference with this additional art still fails to in any way teach, suggest or disclose the above distinguishing features of the presently claimed invention. As such, all of the raised rejections should be withdrawn at this time in view of the above amendments and remarks.

The Applicant notes the remaining prior art cited in the official action. As none of that additional art is applied by the Examiner against the claims of this application, the Applicant is not providing any comments concerning the same at this time.

In view of the above amendments and remarks, it is respectfully submitted that all of the raised rejection(s) should be withdrawn at this time. If the Examiner disagrees with the Applicant's view concerning the withdrawal of the outstanding rejection(s) or applicability of the Hoffman et al. `292 and/or Alperin et al. references, the Applicant respectfully requests the Examiner to indicate the specific passage or passages, or the drawing or drawings, which

contain the necessary teaching, suggestion and/or disclosure required by case law. As such teaching, suggestion and/or disclosure is not present in the applied references, the raised rejection should be withdrawn at this time. Alternatively, if the Examiner is relying on his/her expertise in this field, the Applicant respectfully requests the Examiner to enter an affidavit substantiating the Examiner's position so that suitable contradictory evidence can be entered in this case by the Applicant.

In view of the foregoing, it is respectfully submitted that this application is now placed in a condition for allowance. Action to that end, in the form of an early Notice of Allowance, is courteously solicited by the Applicant at this time.

In the event that there are any fee deficiencies or additional fees are payable, please charge the same or credit any overpayment to our Deposit Account (Account No. 04-0213).

Respectfully submitted,

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